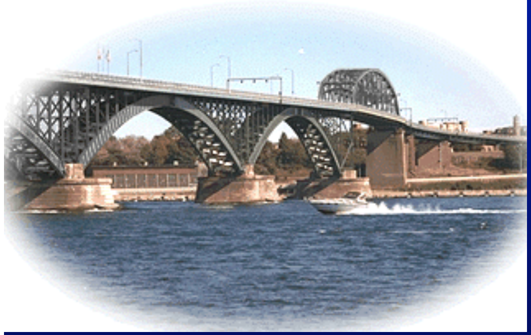
TMS Technology Education Presents:

Structural Engineering Notes



PowerPoint Courtesy of Amherst Middle School Technology Department

4 Types of Bridges

Click on the picture below to answer questions 1 & 2. You will have to read the Section Bridge Basics and click on the links to find the answers.

Efficiency

Your goal as a Structural Engineer is to design and build the most efficient structure. This means that the ***REAL*** winner will be the person who ***spends very little money*** to ***support a lot*** of weight!

This is called **efficiency**, and here is the definition…

Efficiency- compares how much goes in to how much comes out.

(example- How much time, effort, or money does it take to accomplish something? Spend ***less*** to get ***more***!)

Here is how we will determine our winner, the *most efficient* engineer…

Question→ How much does it cost to support 1 pound?

Answer→ Use the *efficiency formula*!

$$\textbf{Efficiency} = \frac{\textbf{Total Cost (\$)}}{\textbf{Critical load (lbs)}}$$

Watch this next example to see how this works…

Engineer	Cost: (millions)	Critical Load: (pounds held)	Efficiency: (cost to support 1 pound)
Amanda	**$189.42**	**60**	**?**

Amanda spe... d... d cost her to ... **1 pound**?

Use the Efficiency formula!

Engineer	Cost: (millions)	Critical Load: (pounds held)	Efficiency: (cost to support 1 pound)
Amanda	$189.42	60	?

$$\text{Efficiency} = \frac{\text{Total Cost (\$)}}{\text{Critical load (lbs)}}$$

$$\text{Efficiency} = \frac{189.42}{60}$$

$$\text{Efficiency} = \$\ 3.16$$

This is her ***efficiency rating,*** or how much money it cost her to support 1 pound!
(Lower the better!)

Who is the ***most efficient engineer*** below?

Use the efficiency formula to complete the chart below…

Engineer	Cost: (millions)	Critical Load: (pounds held)	Efficiency: (cost to support 1 pound)
Tim	$ 114.8[illegible]	[illegible]	?
Jenny	[illegible]	[illegible]	?
Joe	$ [illegible]	[illegible]	?
Sarah	$ 220.21	50	?

It's your turn!

Need a calculator?
Click the picture and click YES→

Efficiency

Calculating efficiency for your bridges:

$$E = \frac{\text{Critical Load on the Bridge}}{\text{MASS OF THE BRIDGE}}$$

Example: The mass of a bridge (BRIDGE A) is 32 grams. The critical load is 45 grams. Calculate the efficiency as a PERCENTAGE!

Efficiency

ANSWER: 1.40 x 100 = 140% Efficient

Example #2: You have a bridge (BRIDGE B) that holds 12g and the bridge has a mass of 43 g. Calculate the efficiency.

27.9%

Which bridge would you rather have? Why?

Definitions:

Critical Load- The amount of weight the structure can withstand before failing (or breaking).

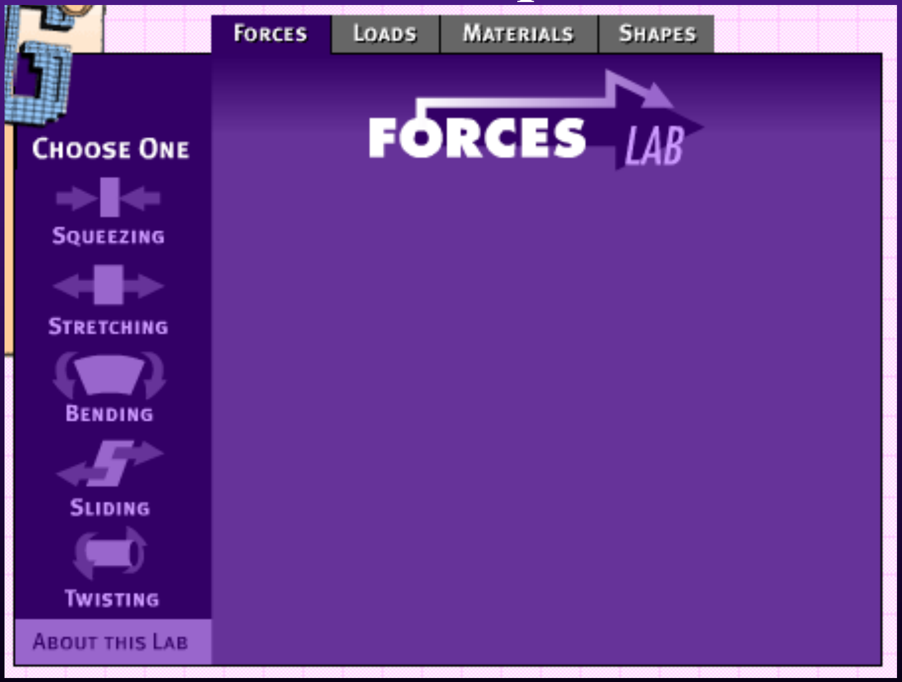
Optimization- The process of redesigning something many times to make it better.

Trade-offs- An exchange of one thing in return for another.

Example- adding more wood makes it stronger (good), but also raises the cost (bad)… which do you choose?

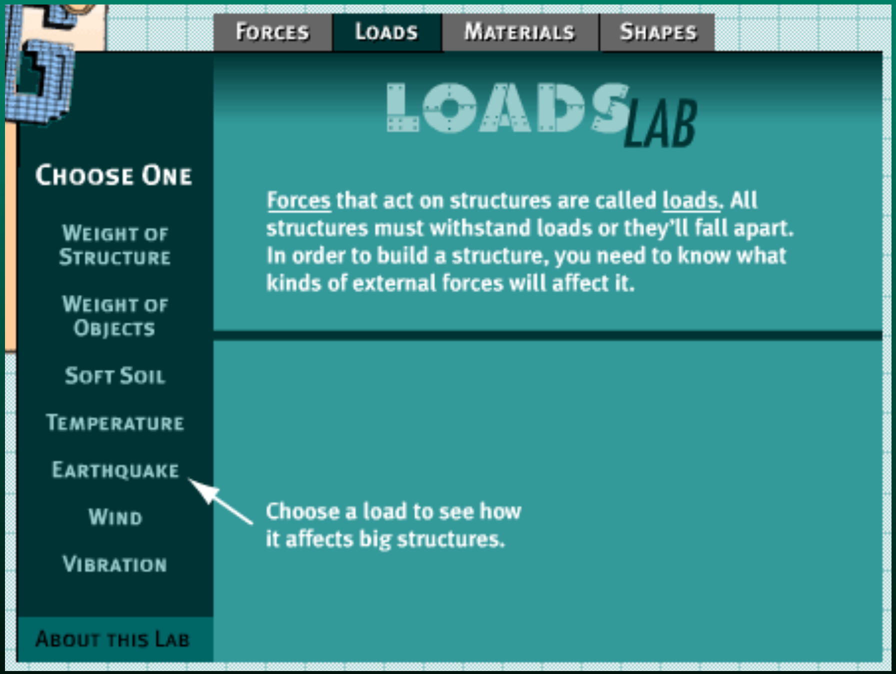
Forces Lab:

Click on the picture hyperlink below to answer questions 15-19. When you are at the web site, click on the forces in the left hand column to answer the questions.



Loads Lab:

Click on the picture hyperlink below to answer questions 20-27. When you are at the web site, click on the forces in the left hand column to answer the questions.

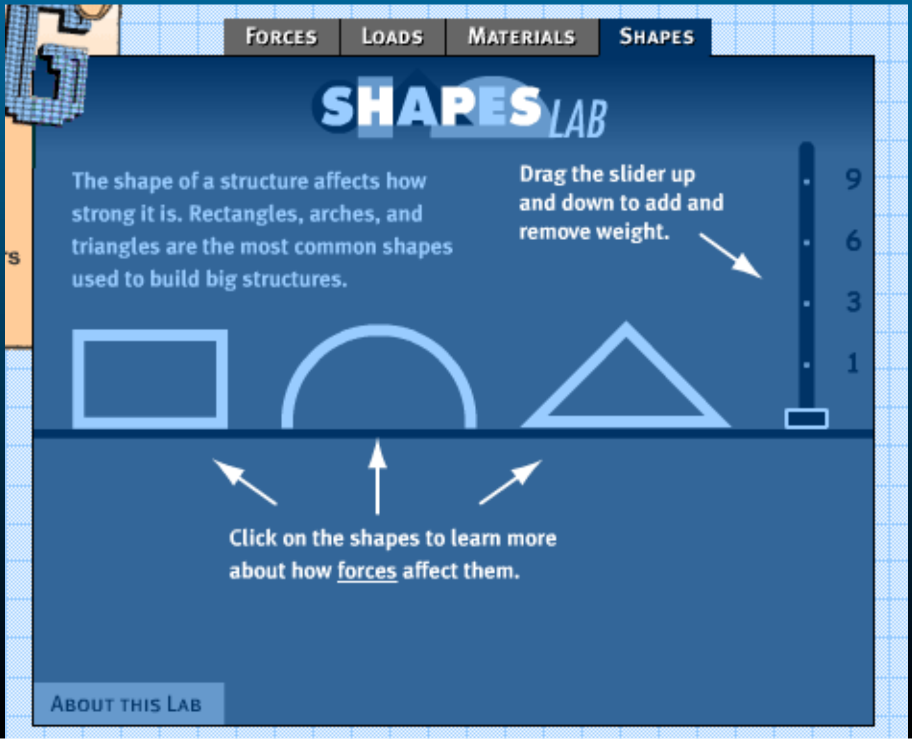


Materials Lab:

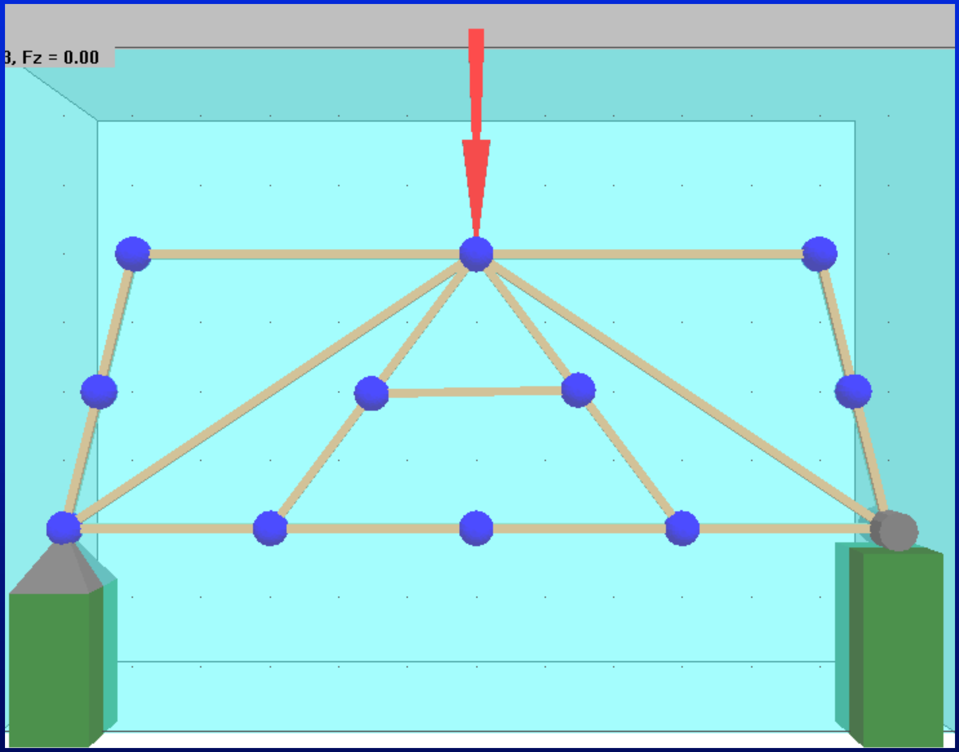
Click on the picture hyperlink below to answer questions 28-34. When you are at the web site, click on the forces in the left hand column to answer the questions.

Shapes Lab:

Click on the picture hyperlink below to answer questions 35-38. When you are at the web site, click on the forces in the left hand column to answer the questions.

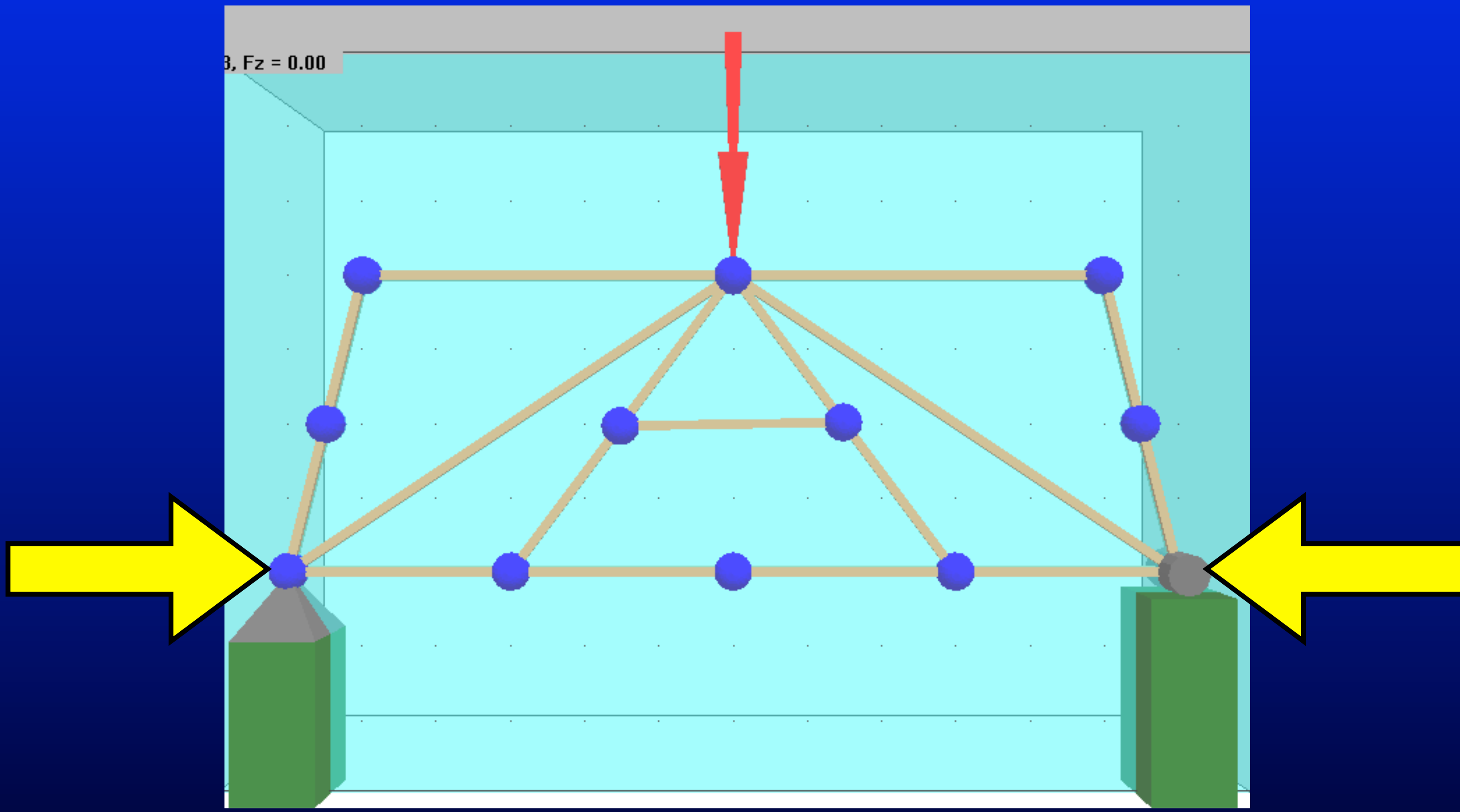


Parts of a Truss:



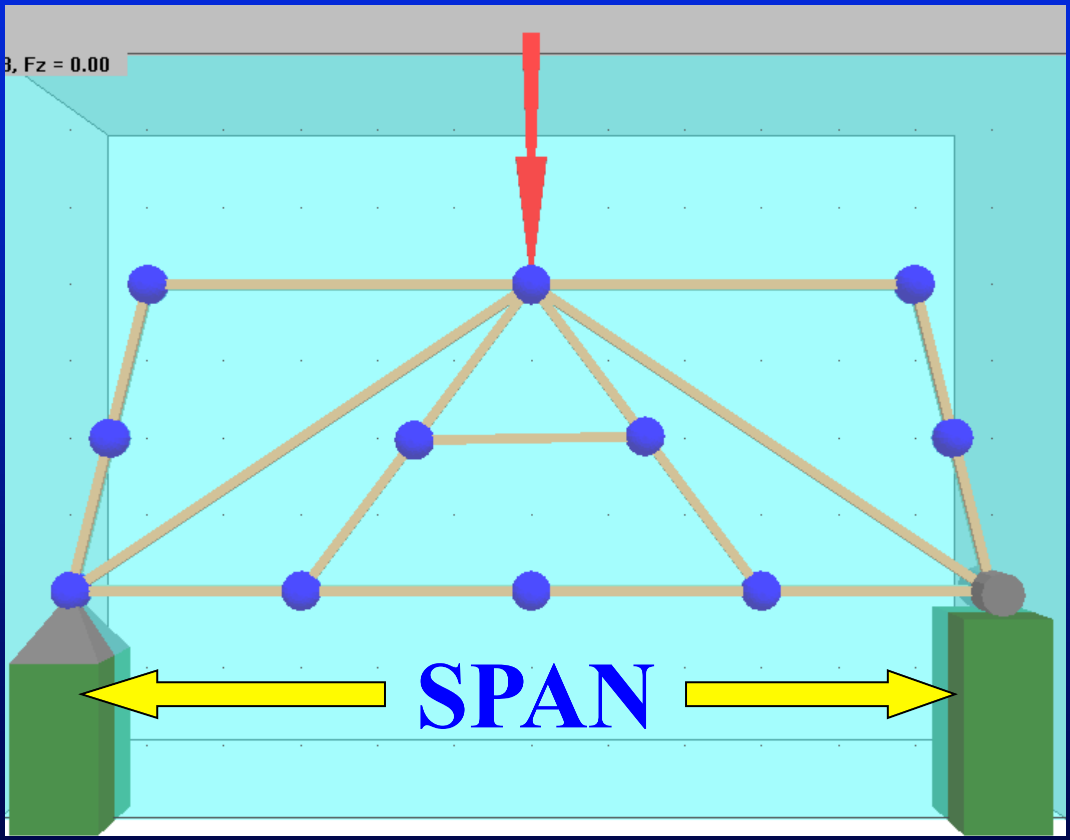
Truss- A structure made up of many pieces connected together. Commonly used in bridges, buildings, and roller coasters.

Parts of a Truss:



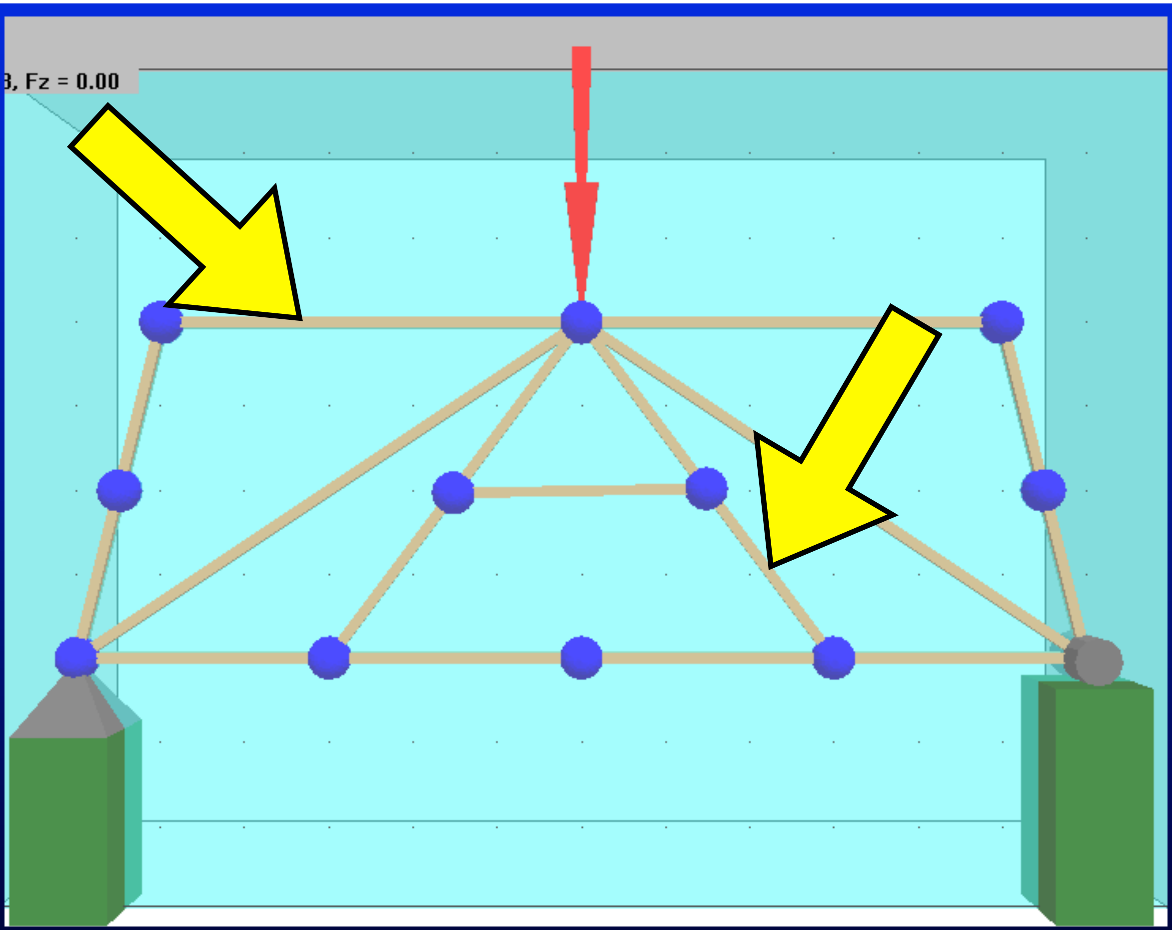
Roadbed- The surface where cars would drive on.

Parts of a Truss:



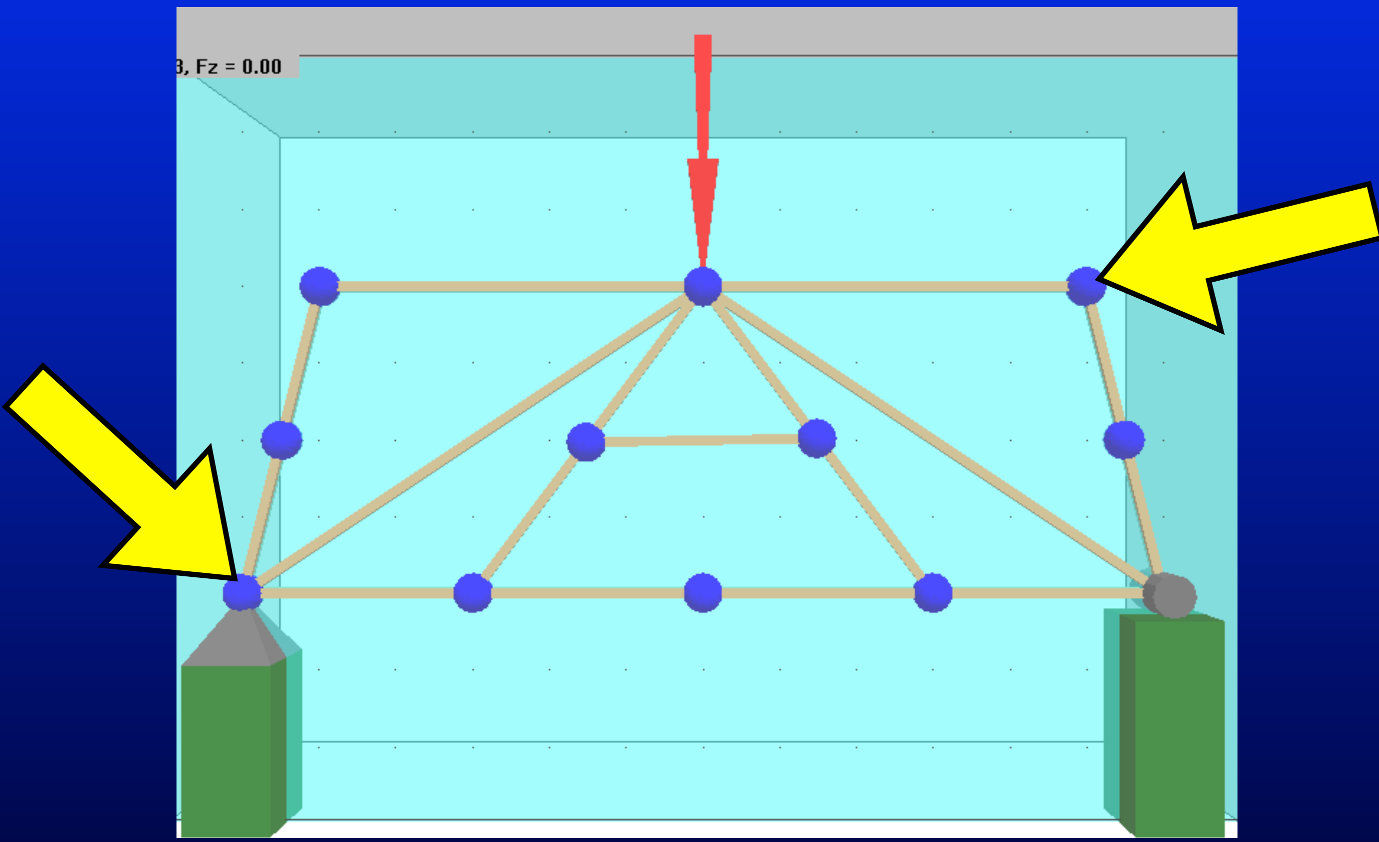
Span- The actual distance the bridge must go over (shorter than the roadbed).

Parts of a Truss:



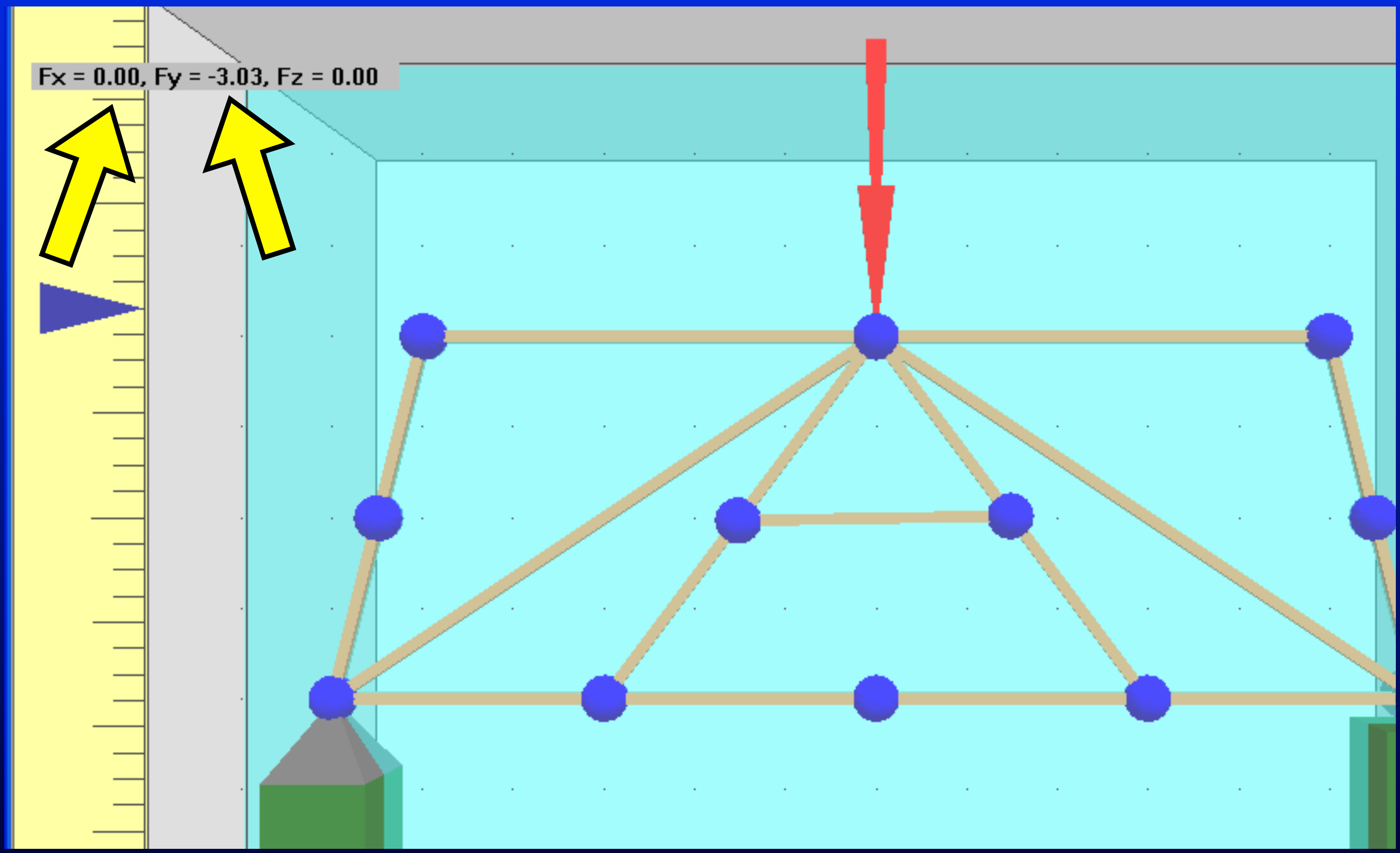
Members- The individual pieces that make up the truss. We will be using balsa wood.

Parts of a Truss:



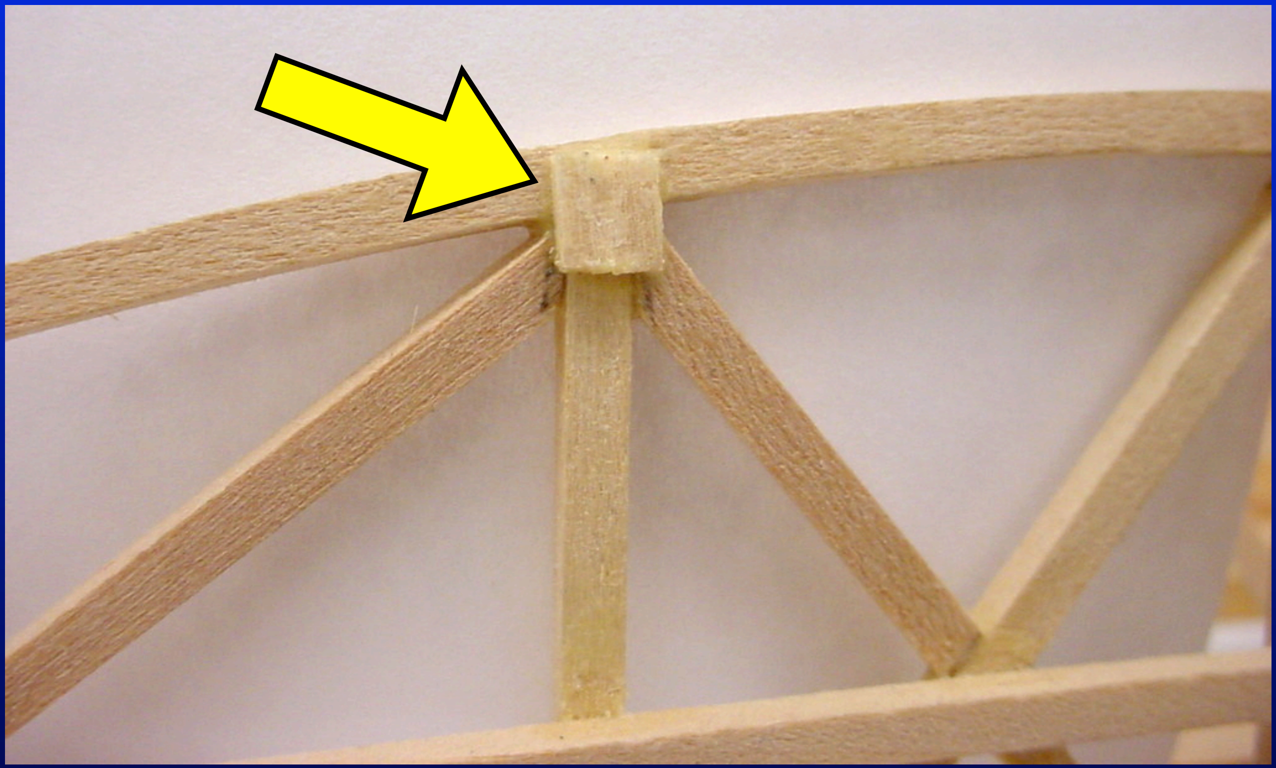
Joints- Where the members intersect, and are glued.

Parts of a Truss:



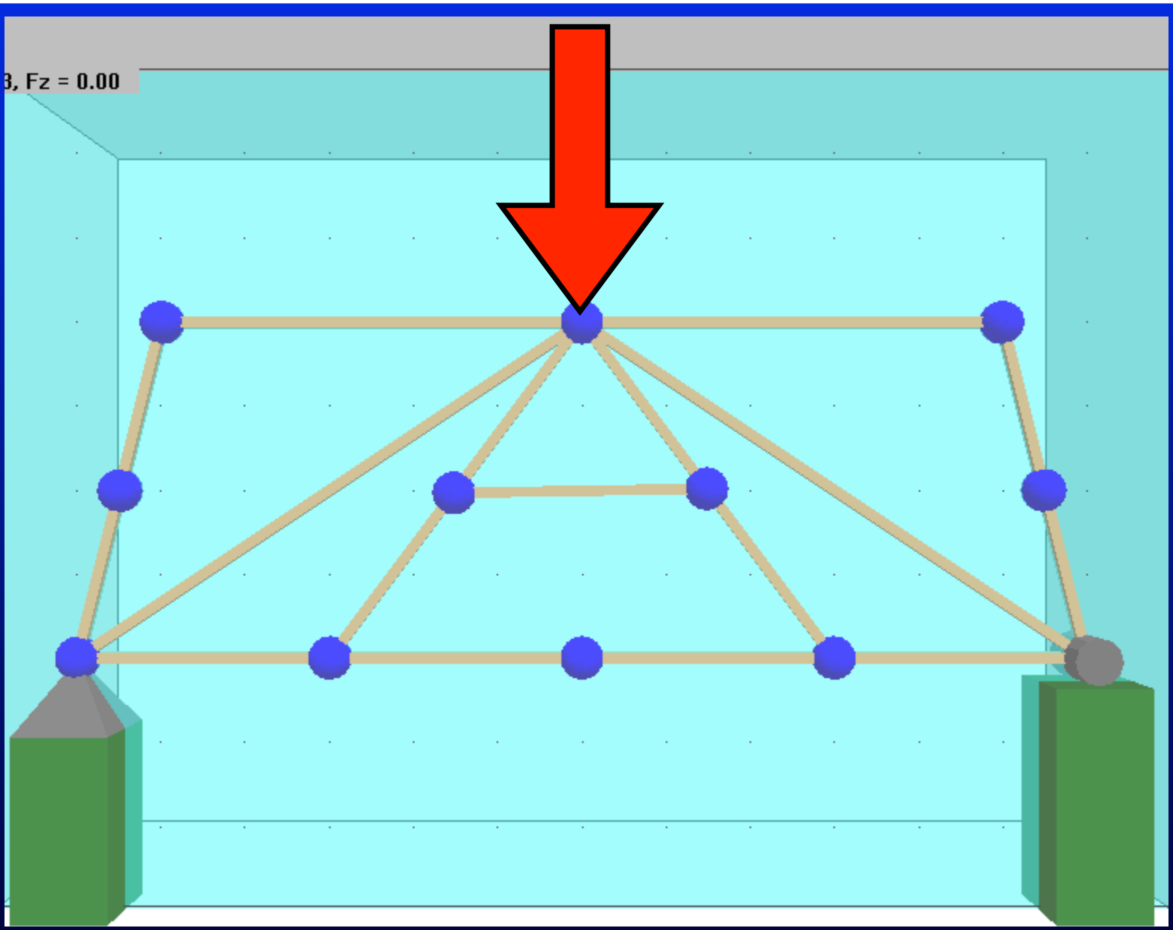
Coordinates- These numbers (called X and Y) tell the location of joints on a grid system.

Parts of a Truss:



Gusset Plates - Cover the joints, strengthening them by adding more glued surface area.

Parts of a Truss:



Force Vector- Shows the location and direction of the applied force.